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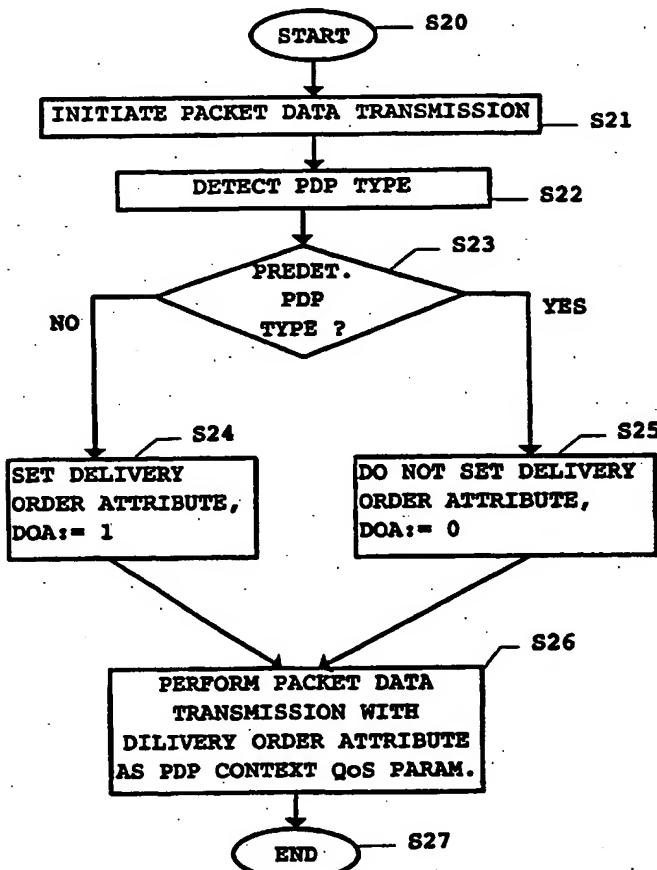
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(54) Title: PACKET DATA TRANSMISSION IN THIRD GENERATION MOBILE SYSTEM



(57) Abstract: The present invention proposes a method for transmission of data packets in a packet data network, said method comprising the steps of: detecting (S31) at least a delivery order attribute (DOA) as a parameter for transmission of data packets; deciding (S32), whether said delivery order attribute parameter is set; and if so determining (S34) a traffic class of the transmitted data packets, and processing the transmitted data packets dependent on the determined traffic class (S35 to S315). Also, the present invention is directed to correspondingly adapted network elements. Furthermore, the invention concerns a method for setting a delivery order attribute (DOA) as a parameter for transmission of data packets in a packet data network.

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TITLE OF THE INVENTION

PACKET DATA TRANSMISSION IN THIRD GENERATION MOBILE SYSTEM

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FIELD OF THE INVENTION

The present invention relates to a method for setting a delivery order attribute as a parameter for transmission of data packets in a packet data network, to a method for transmission of data packets in a packet data network, and to a network element for controlling transmission of data packets in a packet data network which network element is adapted to operate according to the latter.

15

Particularly, the present invention concerns such methods and network elements in connection with the UMTS being currently developed (UMTS = Universal Mobile Telecommunication System), and more specifically, to PDP context QoS parameters and their derivation from available information as well as there use. (PDP = Packet Data Protocol, QoS = Quality of Service).

BACKGROUND OF THE INVENTION

25

Recently telecommunication has made considerable progress. A part of this progress manifests in the fact that a user may access different networks from a single terminal device such as a mobile station MS, and transmit / receive different kinds of data from / with said terminal.

For example, a considerable progress represents the possibility to access the Internet from one's mobile station and to perform data transfer between the Internet and one's mobile station.

5

Such data transfers rely on packet data transmission, according to which data are transmitted in units of packets. An example for a packet data network enabling such a packet data transmission is the GPRS network GPRS-NW roughly illustrated in Fig. 1. (GPRS = General Packet Radio Service) for explanatory purposes. Fig. 1 shows a third generation GPRS network part (3G-GPRS) in the UMTS and the respective corresponding GPRS components.

15 Packet data are for example sent from an external network such as the Internet (or the PSTN = Public Switched Telephone Network) to a terminal device of a user such as a mobile station MS (downlink DL transmission), or vice versa (uplink UL transmission). The subsequent brief explanation 20 of packet data transmission will now refer to the downlink DL transmission.

The connection between the UMTS (GPRS part) network UMTS and the external network is established via a so-called 25 3G-GGSN (= 3rd generation Gateway GPRS Support Node). The 3G-GGSN as a network element transfers the received data via a 3G-SGSN (=3rd generation Serving GPRS Support Node) (this is optionally, since a GGSN may also act as a SGSN in future UMTS standards releases, although at present a SGSN 30 is mandatory) to a (radio) network controller device RNC (in UMTS; corresponding to a base station controller BSC in

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GPRS) adapted top control a (radio) access network consisting of at least one Node B (in UMTS) (which corresponds to a base transceiver station BTS in GPRS) (in case of a radio access network). The access network then 5 accesses and communicates with the user's terminal MS.

In downlink DL, the RNC controls the forwarding of data packets to the mobile station as the destination, while in uplink the GGSN controls the forwarding of data packets to 10 the external network as the destination.

When forwarding such data packets via the packet data network such as a GPRS network, the provisioning of a sufficient quality of the service i.e. the transmission of 15 data packets, is essential. This is referred to as QoS.

Provisioning of QoS in GPRS phase 1 could not be successfully established. In a subsequent GPRS phase 2, and therefore also in a UMTS network, data packets can be 20 transmitted using different transmission protocol types. For example, the following protocol types are supported: UDP (User Datagram Protocol), mostly used for real time applications; TCP (Transmission Control Protocol), PPP (Point to Point Protocol), X.25 protocol, IP (Internet 25 Protocol), OSP:HOSS (Octet Streaming Protocol : Internet Hosted Octet Streaming Service).

All of these PDP types underlie respective different requirements. Also, different applications (e.g. real-time 30 applications and/or non-real time applications) can be run on top of the PDP contexts of the above mentioned PDP

types. However, different applications will require a respective different service from the network.

For example, the X.25 protocol requires the data packets to be sent reliable and delivered in-order, i.e. in the same sequence as they were initially transmitted/forwarded. PPP protocol, on the other hand, requires a less reliable transmission, i.e. some data packets can be lost without significantly affecting QoS, but the data packets not lost have to be delivered in-sequence. Still further, IP protocol based transmissions do neither have to preserve the order of the sent packets nor to be reliable in the sense that no data packets are to be lost.

15 For this purpose, a delivery order attribute as a PDP context QoS parameter has recently been defined. To be included in a set of UMTS bearer QoS parameters. These parameters are still subject to a non-concluded standardization process.

20 The delivery order attribute parameter (DOA) defines for UMTS if the order of transmitted packets has to be maintained or not. In case the order is to be maintained, this leads to the necessity of a node or network element of the network (GPRS comparable part of UMTS) to rearrange the received (disordered) data packets to thereby reconstruct the initial sequence of the data packets as they were sent.

30 However, this additional parameter is hard to define by an end-user who can be expected not to be an expert in telecommunication networks. Namely, such a "normal" end-

user presumably does not know whether such a property (of in-order packets) is necessary for an activated service and/or how the property affects the operation.

- 5 Moreover, in order to support different applications on top of the UMTS bearer, four traffic classes have been developed. Namely, a conversational, streaming, interactive and background traffic class, respectively.
- 10 PDP types mentioned above are independent of the traffic classes. Stated in other words, each PDP type (protocol type) may run over several traffic classes. IN addition, the selection of traffic class sets some requirements for the handling of the prevailing traffic in terms of scheduling and/or buffering of transmitted data packets.
- 15 Also, a delivery order is defined in each traffic class, but this is currently not in line with the requirements imposed to the traffic classes.

20 SUMMARY OF THE INVENTION

Hence, it is an object of the present invention to optimize data packet transmission for different service while simplifying a user interface required for configuring services available to a user.

According to a first aspect of the present invention, this object is achieved by a method for setting a delivery order attribute as a parameter for transmission of data packets in a packet data network, said method comprising the steps of: establishing mapping information for delivery order

attributes corresponding to different transmission protocol types, detecting a transmission protocol type for the transmission of data packets, deciding whether said detected protocol type is a predetermined type, and 5 setting, based on said mapping information and said decision result, the delivery order attribute in case the predetermined protocol type is decided to be not present.

According to a second aspect of the present invention, this 10 object is achieved by a method for transmission of data packets in a packet data network, said method comprising the steps of: detecting at least a delivery order attribute as a parameter for transmission of data packets; deciding, whether said delivery order attribute parameter is set; and 15 if so determining a traffic class of the transmitted data packets, and processing the transmitted data packets dependent on the determined traffic class.

Still further, this object is achieved by a network element 20 for controlling transmission of data packets in a packet data network, said network element comprising: first detecting means adapted to detect at least a delivery order attribute as a parameter for transmission of data packets; first deciding means adapted to decide whether said 25 delivery order attribute parameter is set; first determining means responsive to a positive decision result and adapted to determine a traffic class of the transmitted data packets, and processing means adapted to process the transmitted data packets dependent on the determined 30 traffic class.

Favorable refinements of the present invention are as set out in respective dependent claims.

According to the first aspect of the present invention, the 5 delivery order attribute is set according to a PDP type, i.e. a transmission protocol type. Thus, the value of the delivery order attribute is derived without necessitating an interaction of the end-user. The parameter is thus hidden from the end-user, which makes the design of the 10 user interface UI more simple.

According to the second aspect of the present invention, data packets are transmitted/forwarded based on a combined evaluation of the delivery order parameter and the traffic 15 class. Namely, this aspect of the invention proposes that the way the delivery order is maintained depends on the traffic class of a connection. For example, for real-time RT connections and RT traffic classes, delayed data packets P_k which are received after a packet P_i ($i > k$) are 20 discarded, while for non-real-time NRT connections, packets are buffered and reordered. This is done in case the delivery order is required to be maintained. Stated in other words, NRT packet delivery is both, in-sequence (if required) and more reliable. In summary, a reordering 25 process for data packets is optimized for different services.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in the following 30 with reference to the drawings, in which

Fig. 1 illustrates a simplified block diagram of a GPRS network and/or corresponding functional units of a UMTS;

5 Fig. 2 is a flowchart explaining a first aspect of the present invention in greater detail;

Fig. 3 (Fig. 3A & 3B) is a flowchart explaining a second aspect of the present invention in greater detail; and

10 Fig. 4 shows a block diagram of a network element according to the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

15 According to a first aspect of the present invention, the delivery order attribute DOA is derived from a PDP type, i.e. transmission protocol type, respectively. For example, considering a case of traffic, i.e. transmission of data packets relying on UDP protocol, which in most cases is used for real time traffic. In connection with real time traffic, it is preferred to discard some data packets instead of starting buffering of data packets and waiting for individual packets that are lost or at least received with delay. In such a case, the delivery order attribute 20 should not be set, i.e. should for example be set to a value of zero indicating that the data packets need not be delivered/forwarded in the sequential order in which they were initially transmitted (ordering not required). On the other hand, PPP and X.25 protocols, for example, are used 25 to run applications which require or at least benefit from packets being delivered / forwarded (i.e. received at the 30

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destination) in their initial order (sequence) in which they were transmitted from the sender side. Moreover, TCP, which does not require that the delivery order is being kept, will benefit from the delivery order being

5 maintained. Also in such a case, the PDP type, namely the protocol type, can be used to decide whether the delivery order attribute is to be set, and if such a protocol type is present, the delivery order attribute is set to a value indicating that a delivery of data packets is required in

10 sequence (the initial sequence of sending). New radio interface such as MAC (Medium Access Control) / RLC (Radio Link Control) defined in UMTS require to be configured to deliver data packets either to be in order to deliver data packets not necessarily in order, i.e. out of order

15 delivery is permissible.

Fig. 2 shows a more detailed flow chart of this proposed method for setting a delivery order attribute as a parameter for transmission of data packets in a packet data network.

The method starts in a step S20, which is followed by an initiation of packet data transmission in step S21.

25 Thereafter, in step S22, a PDP type is detected after a mapping information has been established, which mapping information has been established for delivery order attributes corresponding to different transmission protocol types. Namely, information regarding the used transmission

30 protocol type (and associated delivery order attributes) is acquired.

In a following step S23 it is then decided, whether the detected protocol is a predetermined one. Also, this is intended to mean that it is decided whether the detected 5 protocol is part of a predetermined group of protocols (a group of protocols in the simplest case consists of one protocol only). That is, there exist different protocols of which part require in-sequence delivery and part do not require in-sequence delivery. A predetermined type of 10 protocol referred to herein below refers to a protocol or a set of protocols which do not require in-sequence delivery.

If a predetermined type of protocol is decided to be present (YES in step S23), the flow branches to step S25. 15 Stated in other words, steps S22 and S23 detect a PDP type and decide whether it requires in-sequence delivery or not. This may be the case in the event that UDP as a protocol for real-time transmission has been detected to be present, as mentioned before. Then, in step S25, the delivery order 20 attribute is not set, i.e. assumes a value of zero, for example.

On the other hand, if said predetermined type has not been detected (NO in Step S23) (e.g. a type has been detected 25 which is not used for RT but rather for NRT transmissions), the flow branches to step S24. IN step S24, the delivery order attribute is set to a value (e.g. DOA=1) indicating that delivery of data packets is required in sequence (the initial sequence of sending)

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After step S24 as well as after step S25, the flow is combined and proceeds with a step S26. In step S26, the packet data are transmitted together with the delivery order attribute DOA (being set (DOA=1) or not set (DOA=0)).

5

The flow then ends in step S27.

As a still further alternative (not shown in the Figure), if due to the automatic setting of the delivery order 10 parameter some advantageous other properties of transmission are adversely affected (e.g. transmission quality falls below a predetermined quality threshold), the final decision as to the setting of the DOA parameter may be left to the user again, or the parameter may be set to a 15 fixed value.

According to a second aspect of the invention, the above set/or non-set delivery order attribute is evaluated in the course of transmitting data packets. Specifically, the 20 transmission is based on the combined evaluation of PDP type requirements and traffic classes, so that a proper handling of the delivery order parameter in a respective traffic class is resulting therefrom.

25 In brief, because in real-time traffic classes the data packet scheduling and forwarding must be fast, i.e. real-time with hardly any buffering, there cannot be buffering of data packets even if the packets are received in a wrong order while an in-sequence delivery of the data packets is 30 required (i.e. the delivery order parameter DOA is set, DOA=1, for the PDP context, namely the protocol type).

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Packets being received out of order are deleted and/or discarded. So, for example, for a packet stream of #1, #2, #3, #5, #6, #4, #7, #8 being received, packet #4 will be deleted.

5

On the other hand, in connection with non-real-time traffic, it makes sense to wait for some time for data packets not yet arrived in order to be able to reorder the flow of packets. As a specific example only, the ordering 10 is based on sequence numbers contained in GTP headers (GPRS Tunneling Protocol) of the data packets. Nonetheless ordering can be based on RLC numbering in the radio interface, i.e. on the information contained in an RLC header, as a further example. Generally, this can be based 15 on the information contained in any header, as long as the respective header contains an indication related to the sequence of the packets.

Therefore, according to the second aspect of the present 20 invention the delivery/forwarding, i.e. transmission of data packets is proposed to be handled as follows:

I.) CONVERSATIONAL AND STREAMING TRAFFIC CLASSES

(more generally: a first type of traffic class or first

25 type group of traffic classes)

If a delivery order attribute is not set, all incoming data packets are forwarded immediately (or at least as soon as possible).

30

However, in case the delivery order attribute has been set, a network element (e.g. RNC in downlink direction, GGSN in uplink direction of transmission) checks the order of, i.e. a sequential relationship among data packets before they 5 are forwarded to a respective destination (mobile station terminal in downlink, external network such as Internet in uplink). (It should be noted that the check could also be conducted by the closest network node after transmission, so e.g. by the SGSN.) If a data packet (or more than one) 10 arrives after the subsequent packet (with reference to the initial order of the packets upon sending), and the data packets arrive thus in a wrong order, the disordered packet(s) is/are discarded to thereby preserve the right order of packets, since buffering and waiting for possibly 15 disordered data packets does not make sense in case with this real-time traffic related traffic class.

II.) INTERACTIVE AND BACKGROUND TRAFFIC CLASS

(more generally: a second type of traffic class or second 20 type group of traffic classes)

If a delivery order attribute is not set, all incoming data packets are forwarded immediately (or at least as soon as possible). (In this connection, the behavior is similar to 25 the first class.)

In case the delivery order attribute parameter has been set, the network element (e.g. RNC in downlink direction, GGSN in uplink direction of transmission) checks the order 30 of, i.e. a sequential relationship among data packets before they are forwarded to a respective destination

(mobile station terminal in downlink, external network such as Internet in uplink).

If a data packet is missing, the (next) data packets will
5 be buffered and the missing data packet will be waited for,
at least for a specified waiting time also referred to
hereinafter as a buffering time window. This is for example
controlled by a timing device which controls buffering and
waiting. When the timer expires, i.e. the buffering time
10 window has lapsed, the buffered data packets buffered so
far are sent and a possibly disordered data packet is
dropped or discarded even if it arrives later. In case the
missing data packet arrives prior to the lapse of the
buffering time window, the buffer can be emptied and the
15 sending/forwarding is continued until a next packet is
missing. In this case, of course, the buffered data packets
are reordered and sent in their initial sequence, with the
reordering being based on the sequence number contained in
the a header such as the GTP header or RLC header (or any
20 other suitable header containing such sequence number
information) of the packets.

This ensures, that during most time of the transmission,
the NRT (non real time) packet delivery is effected both,
25 in sequence (if required) and reliable (in that only few
data packets are missing and transmission quality is not
degraded due to a disordered data stream at the
destination). A delay caused in this case does not cause a
remarkable deterioration since NRT can cope with delays and
30 even with variations in delay.

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In addition to traffic class information mentioned above, also bit error rate (BER) and/or packet loss ratio parameter values may be referred to in order to influence the decision as to whether data packets are to be buffered 5 or not for a certain PDP context, i.e. transmission protocol. Also, a combined consideration of the previous attribute values and a Maximum transfer Delay value may be used to define an appropriate value for the buffering time window (and/or buffer size).

10

Fig. 3 now shows a more detailed flow chart of this proposed method for transmission of data packets in a packet data network according to the invention.

15 With reference to Fig. 3A, the method starts in a step S30. Thereafter, in step S31, PDP context QoS parameters are detected. Among such parameters, at least a delivery order attribute parameter DOA is detected.

20 In step S32, it is decided whether said delivery order attribute DOA is set or not. If said delivery order attribute DOA is not set (NO in step S32), the flow branches to step S33. According to step S33, data packets are forwarded immediately (or at least as soon as possible) 25 in the order of their receipt to the destination. Then, the flow ends in a subsequent step S333.

If however, it is decided in step S32, that the DOA parameter is set (YES in step S32), the flow proceeds to 30 step S34.

In step S34, a traffic class of the prevailing traffic is determined. The subsequent processing is dependent on the determined traffic class.

5 Namely, in a following step S35, it is decided whether the determined traffic class is a predetermined one (or belongs to a predetermined group of traffic classes, e.g. RT or NRT traffic classes). More precisely, in step S35 it is decided whether the determined traffic belongs to a first type of
10 traffic class (or traffic classes). In the chosen example, this first type of traffic class(es) is defined to represent a real-time traffic class.

If this is confirmed in step S35 (YES in step S35), namely,
15 if said traffic is RT traffic such as conversational / streaming traffic, the flow branches and proceeds with step S36. In step S36, disordered packets are discarded and only the remaining packets are sent/forwarded to the destination in their initial order in which they were sent. For example, if a stream of data packets of packets #1, #2, and
20 #3 is initially sent in this order, and packets are received by the network element in the course of transmission to the destination such as a mobile station MS in the order #1, #3, and #2, the disorder is detected due
25 to the comparison of header information for the packets (e.g. information included in the GTP header, RLC header or any other suitable header), packet #2 is discarded and only packets #1 and 3 (thus in their correct order) are forwarded further to the destination. The flow then ends in
30 a step S333.

In contrast, if in step S35 a predetermined first type of traffic is not decided to be present, i.e. in the described example, NRT traffic is concluded to be present, the flow advances to step S37 (see Fig. 3B).

5

According to step S37 the sequence of received data packets is determined, i.e. a sequential relationship among the received packets is monitored. In a subsequent step S38, it is detected whether a data packet is missing in the sequence of received / monitored data packets.

10

With reference to the above example, it is checked whether packets #1, #2, and #3 ... are received in this order or whether for example packet #2 is missing.

15

If no such packet is missing (NO in step S38), the flow branches to step S39 and the received packets are sent / forwarded in the received order (which in this case is also the order of initial sending thereof). The flow then ends 20 in step S333.

If, however, a packet is missing (e.g. packet #2) (YES in step S38), the method proceeds with step S310.

25

In step S310, a buffer timer is set, thereby setting a buffering time window, during which time window received data packets are buffered. The received data packets are buffered in step S311 and it is waited for the receipt of the missing data packet (or packets). During the waiting, 30 it is checked, whether the timer has expired (the time window has lapsed or not).

If the timer has expired (YES in step S312), the flow proceeds to step S313, where the buffered data packets are sent/forwarded from the buffer to the destination. This 5 implies that the missing data packets, if still received later, are discarded. With reference to the example given in connection with the three packets, if packet #2 is not received during the buffering time window, only packets #1 and #3 are forwarded and packet #2 is discarded if received 10 later. The flow then ends in step S333. (it should be noted that the discarding of "late-received", i.e. disordered packets such as packet #2 is not necessary in all cases, so that in the given example there might be cases in which packet #2 is also sent to the destination.)

15

If, however, the timer has not expired (NO in step S312), the flow proceeds to step S314, where it is checked whether a missing data packet (or plural missing packets) have been received.

20

If the packet(s) is(are) received (YES in step S314), the flow proceeds to step S315. In step S315 the buffered data packets are reordered to their initial sequence order (based on the sequence number information contained in a 25 suitable header such as for example the GTP header, RLC header, LLC header, SNDCP header (layer on top of LLC in GPRS), etc.) and forwarded in their initial sequence order.

Referring to the given example, if packets #1 and #3 have 30 been buffered and packet #2 is received during the buffering time window so that packets #1, #3, and #2 are

present, these are reordered and forwarded in their initial sending sequence order of packets #1, #2, and #3 to their destination.

- 5 If, however, the packets are not received (NO in step S314) the flow returns to step S311, and buffering and waiting for missing packets continues until either the timer expires or the missing packet(s) is(are) received.
- 10 The preceding detailed description has been given with particular reference to the method. However, the present invention also relates to a corresponding device and/or network element for controlling transmission of data packets in a packet data network, said network element comprising a first detecting means adapted to detect at least a delivery order attribute as a parameter for transmission of data packets, a first deciding means adapted to decide whether said delivery order attribute parameter is set, a first determining means responsive to a positive decision result and adapted to determine a traffic class of the transmitted data packets, and a processing means adapted to process the transmitted data packets dependent on the determined traffic class.
- 15
- 20
- 25 In detail, such a network element NW-ELEMENT is shown in Fig. 4 of the enclosed drawings. Transmitted data packets are supplied to the network element and input to a first detecting means, which is connected to a first deciding means, which in turn is connected to a first determination means and a subsequent processing means.

The processing means as such comprises, as shown in the lower part of Fig. 4, a second deciding means connected to a discarding means and a monitoring means which are responsive to respective decision results of said second 5 deciding means.

The monitoring means as such is connected to a second detecting means, an output signal of which is supplied to a buffer means. The buffer means buffers the data packets 10 supplied thereto via an input (not shown) responsive to the signal supplied from the second detecting means. The buffer means is set from by means of a setting means, while a checking means checks the buffer means in regard of packets and/or the order of packets buffered therein.

15 The data buffered are read out from the buffer means and supplied to a forwarding/reordering means which either forwards the buffered data or reorders the buffered data packets dependent on a control signal supplied to the 20 forwarding / reordering means from the checking means. (The processing as performed by these latter means is substantially the one as described in connection with the flowchart Fig. 3B, particularly steps S311 to S315.)

25 The location of such a device / network element within the network is dependent on the transmission direction of the data packets. For example, in connection with downlink DL transmission, the device will be implemented as part of the RNC as a network element, while in connection with uplink 30 traffic, the device will be implemented as part of the GGSN as a network element.

It is apparent to those skilled in the art that each of the methods steps and its functionality as described herein before can be transferred to a corresponding hardware means 5 adapted to perform the same functionality as described in connection with the method step, so that a detailed description of a correspondingly adapted device is considered to be dispensable.

10 As has been described herein before, the present invention proposes a method for transmission of data packets in a packet data network, said method comprising the steps of: detecting S31 at least a delivery order attribute DOA as a parameter for transmission of data packets; deciding S32, 15 whether said delivery order attribute parameter is set; and if so determining S34 a traffic class of the transmitted data packets, and processing the transmitted data packets dependent on the determined traffic class S35 to S315. Also, the present invention is directed to correspondingly 20 adapted network elements. Furthermore, the invention concerns a method for setting a delivery order attribute DOA as a parameter for transmission of data packets in a packet data network.

25 It should be understood that the above description and accompanying figures are merely intended to illustrate the present invention by way of example only. The preferred embodiments of the present invention may thus vary within the scope of the attached claims.

CLAIMS

1. A method for setting a delivery order attribute (DOA) as a parameter for transmission of data packets in a packet data network (GPRS-NW),
5 said method comprising the steps of:
establishing mapping information for delivery order attributes corresponding to different transmission protocol types;
10 detecting (S22) a transmission protocol type for the transmission of data packets,
deciding (S23) whether said detected protocol type is a predetermined type, and
setting (S24), based on said mapping information and
15 said decision result, the delivery order attribute (DOA) in case the predetermined protocol type is decided to be not present.
2. A method according to claim 1, wherein said set
20 delivery order attribute (DOA) indicates that the order of transmitted data packets is to be maintained.
3. A method according to claim 1, wherein said delivery order attribute (DOA) is not set (S25) in case the
25 predetermined protocol type is decided to be present.
4. A method according to claim 3, wherein said delivery order attribute being not set indicates that the order of transmitted data packets does not need to be
30 maintained.

5. A method according to claim 1, wherein said predetermined protocol type is a protocol type used for real-time transmission.
- 5 6. A method according to claim 1, wherein said transmission protocol type is derived from PDP context information or PDP type information.
- 10 7. A method for transmission of data packets in a packet data network, said method comprising the steps of:
 - detecting (S31) at least a delivery order attribute (DOA) as a parameter for transmission of data packets;
 - deciding (S32), whether said delivery order attribute parameter is set; and if so
 - 15 determining (S34) a traffic class of the transmitted data packets, and
 - processing (S35-S39, S310-S315) the transmitted data packets dependent on the determined traffic class.
- 20 8. A method according to claim 7, wherein if said delivery order attribute is set, this indicates that the order of transmitted data packets is to be maintained.
- 25 9. A method according to claim 7, wherein if said delivery order attribute is not set, this indicates that the order of transmitted data packets does not need to be maintained.
- 30 10. A method according to claim 9, wherein data packets to be transmitted are forwarded (S33) to their destination immediately and irrespective of the traffic class.

11. A method according to claim 7 or 8, further comprising the steps of:

5 deciding (S35) whether a determined traffic class is a predetermined traffic class, and if so

discarding (S36) those of received data packets which are received after subsequently sent data packets.

12. A method according to claim 7 or 8, further comprising 10 the steps of:

deciding (S35) whether a determined traffic class is a predetermined traffic class, and if not so

monitoring (S37) a sequential relationship among received data packets,

15 detecting (S38) whether a data packet is missing in the monitored sequence, and

in response to the detection of a missing data packet, buffering (S311) received data packets.

20 13. A method according to claim 12, further comprising a step of

setting (S310) a buffering time window, during which time window received data packets are buffered.

25 14. A method according to claim 13, further comprising a step of

checking (S314) whether the missing data packet is received during the buffering time window.

30 15. A method according to claim 14, wherein

- 25 -

if said missing data packet is not received during the buffering time window (S314, S312),

5 said buffered data packets are forwarded (S313) irrespective of the missing data packet, which is discarded even if received after the buffering time window.

16. A method according to claim 14, wherein

if said missing data packet is not received during the buffering time window (S314, S312),

10 said buffered data packets are forwarded (S313) irrespective of the missing data packet, which is delivered out of sequence even if received after the buffering time window.

15 17. A method according to claim 14, wherein

if said missing data packet is received (S314) during the buffering time window,

20 said buffered data packets are reordered to their initial sequence order and forwarded in their initial sequence order (S315).

18. A method according to claim 17, wherein

25 said reordering is based on sequence numbers of the packets contained in headers of the packets.

19. A method according to claim 18, wherein

25 said headers are GTP (GTP = GPRS Tunneling Protocol) headers, RLC (Radio Link Control) headers, LLC (Logical Link Control) headers or SNDCP headers of the packets.

20. A network element for controlling transmission of data packets in a packet data network, said network element comprising:

- first detecting means adapted to detect at least a 5 delivery order attribute (DOA) as a parameter for transmission of data packets;
- first deciding means adapted to decide whether said delivery order attribute parameter is set;
- 10 first determining means responsive to a positive decision result and adapted to determine a traffic class of the transmitted data packets, and
- processing means adapted to process the transmitted data packets dependent on the determined traffic class.

15 21. A network element according to claim 20, wherein said processing means further comprises:

- second deciding means adapted to decide whether a determined traffic class is a predetermined traffic class, and
- 20 discarding means responsive to a positive result of said second deciding means and adapted to discard those of received data packets which are received after subsequently sent data packets.

25 22. A network element according to claim 20, wherein said processing means further comprises:

- second deciding means adapted to decide whether a determined traffic class is a predetermined traffic class, and

monitoring means responsive to a negative result of said deciding means and adapted to monitor a sequential relationship among received data packets,

5 second detecting means adapted to detect whether a data packet is missing in the monitored sequence, and buffer means responsive to the detection of a missing data packet and adapted to buffer received data packets.

10 23. A network element according to claim 22, wherein said processing means further comprises:

setting means adapted to set a buffering time window, during which time window received data packets are buffered.

15 24. A network element according to claim 23, wherein said processing means further comprises:

checking means adapted to check whether the missing data packet is received during the buffering time window.

20 25. A network element according to claim 24, wherein said processing means further comprises:
forwarding means adapted to forward,

if said missing data packet is not received during the buffering time window,

25 said buffered data packets irrespective of the missing data packet, and to discard the missing data packet even if received after the buffering time window.

30 26. A network element according to claim 24, wherein said processing means further comprises:
reordering means adapted to reorder,

if said missing data packet is received during the buffering time window,

said buffered data packets to their initial sequence order, and to forward the buffered data packets in 5 their initial sequence order.

27. A network element according to any of the preceding claims 20 to 26, wherein said network element is a radio network controller (RNC) controlling the transmission of 10 data packets in a packet data network in downlink direction.

28. A network element according to any of the preceding claims 20 to 26, wherein said network element is a GGSN 15 (Gateway GPRS Support Node) controlling the transmission of data packets in a packet data network in uplink direction.

FIG. 1

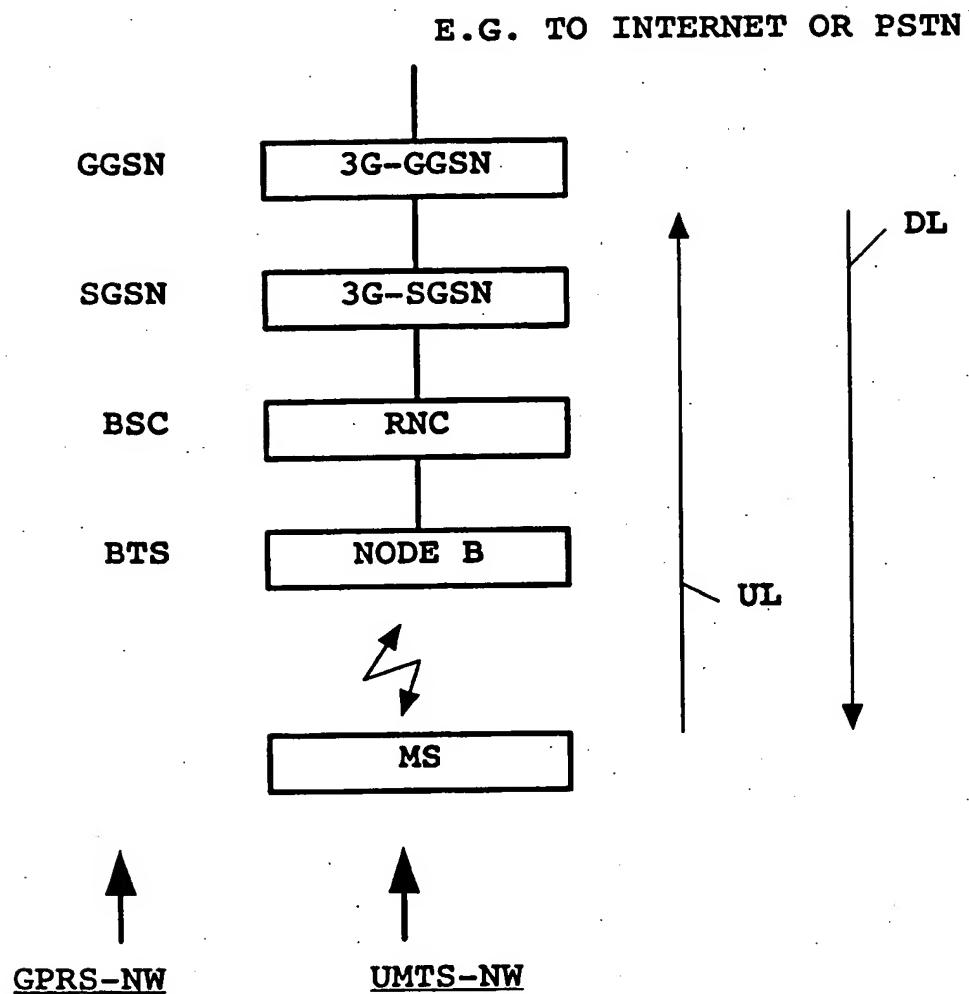


FIG. 2

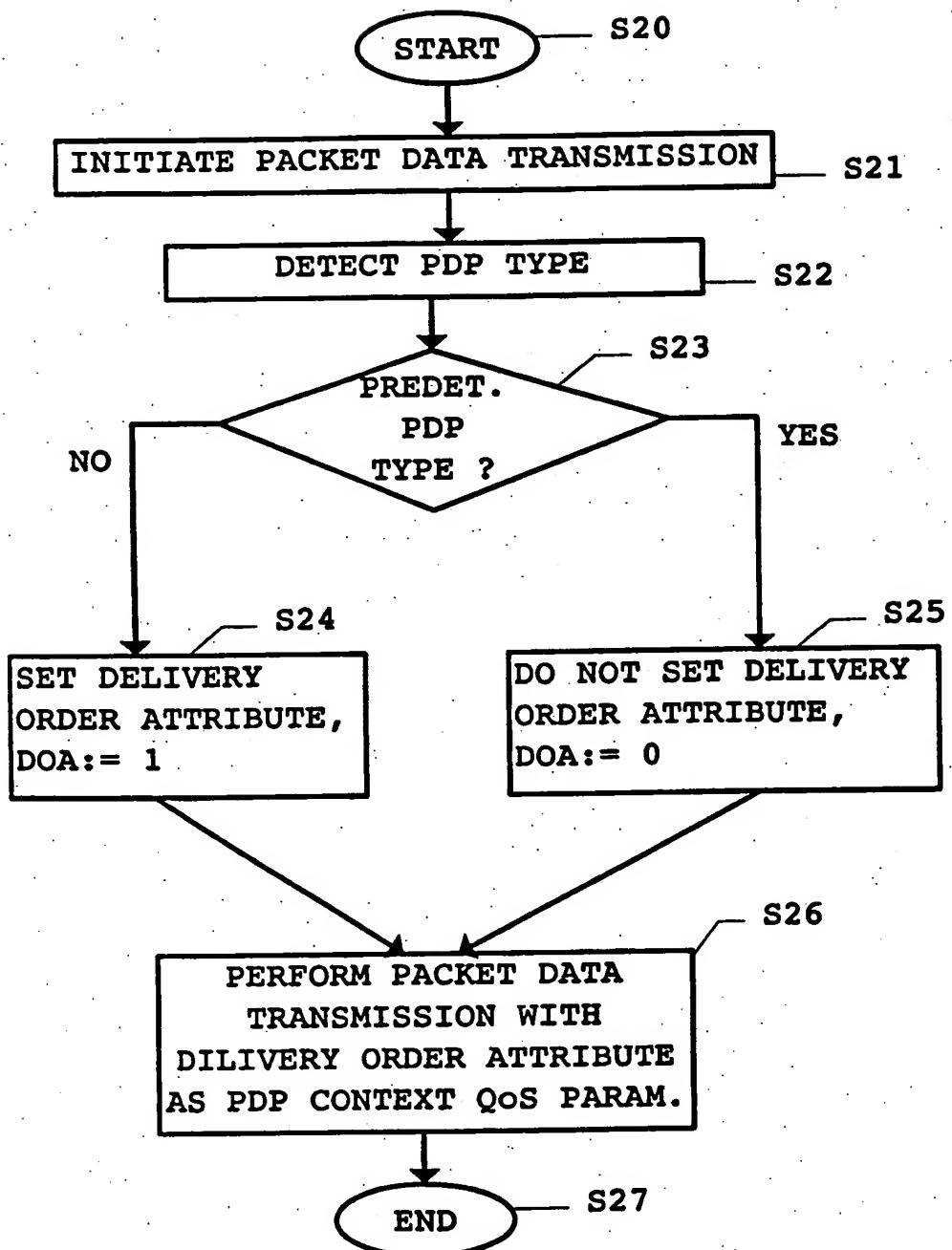


FIG. 3A

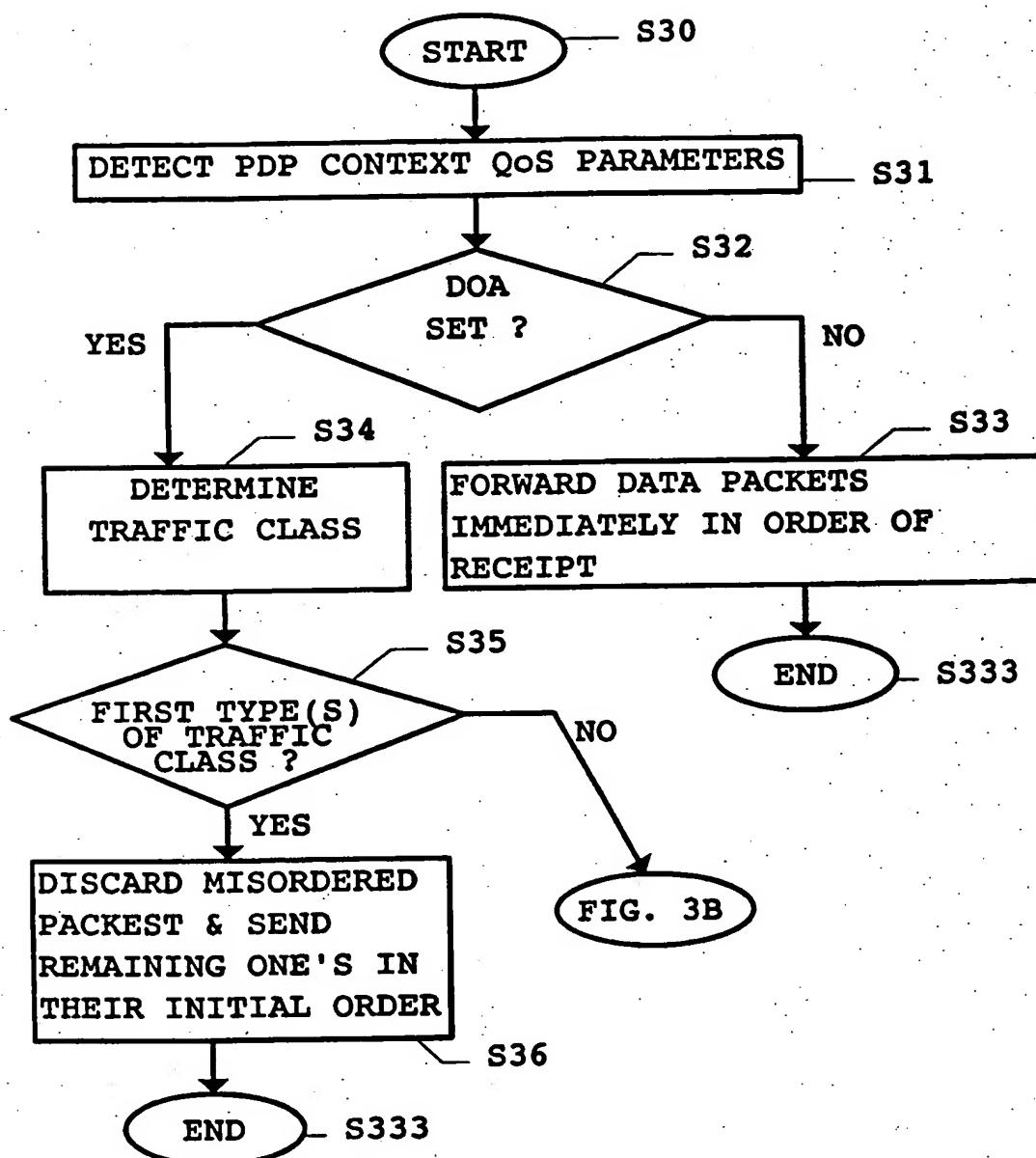


FIG. 3B

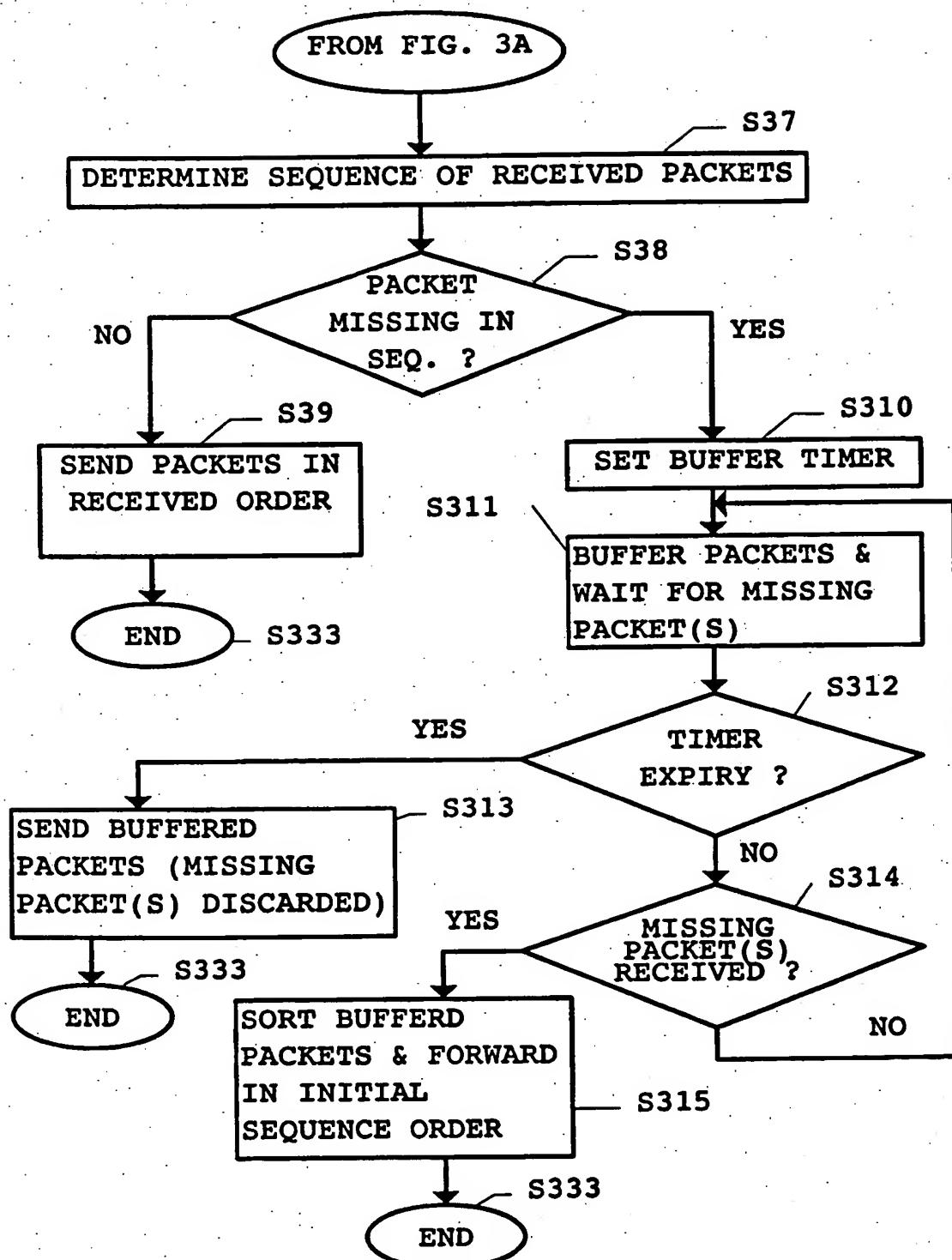
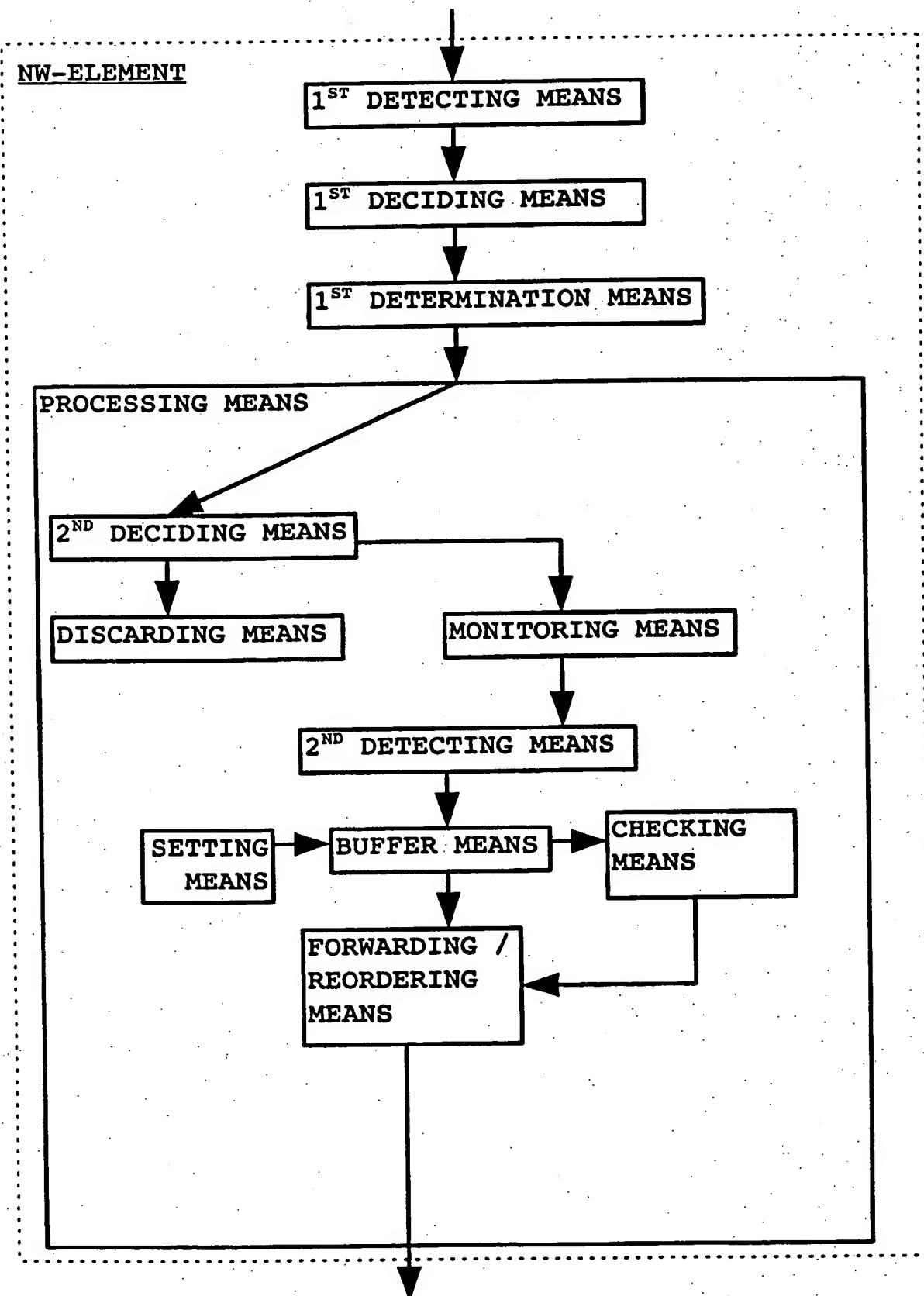


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/03517

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/28 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>"Technical Specification Group Services and System Aspects; QoS Concept (3G TR 23.907 version 1.1.0)" 3RD GENERATION PARTNERSHIP PROJECT, 'Online! May 1999 (1999-05), XP002130868 Retrieved from the Internet: <URL:www.3gpp.org/TSG/June_status_list.htm > 'retrieved on 2000-02-15! page 20, line 14 -page 23, line 1</p>	1,2,4, 7-9,20
A	<p>WO 97 22201 A (XIE DONG; CAMPBELL ROY H; CHEN ZHIGANG; TAN SEE MONG) 19 June 1997 (1997-06-19) page 6, line 4 -page 7, line 13</p>	1,7,20

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/EP 99/03517

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9722201	A 19-06-1997	EP 0867003 A	30-09-1998